

## Correspondence

# Comparison of electrocardiographic and echocardiographic measures of left ventricular hypertrophy in the assessment of aortic stenosis

Sir,

The paper by Dr Dancy (1986;55:155-61) includes considerable discussion of a formula for the echocardiographic assessment of severity of aortic stenosis first described by myself and colleagues in this journal in 1975.<sup>1</sup> This formula is based on the close relation between the relative thickness of the left ventricular wall (the ratio of wall thickness to cavity size) and peak left ventricular pressure when ventricular function is not impaired. The ratio is increased by concentric hypertrophy due to pressure overload but not by eccentric hypertrophy that is caused by volume overload. I would like to respond to several points made by Dancy:

(a) I agree that it is often not possible to record a first class echocardiogram that is essential for measurement of relative wall thickness and that this limits the applicability of the method.<sup>2</sup> I am surprised that Dancy bothered to make any measurements in the 119 patients from whom only poor quality records were available. Had the study been carried out prospectively with the aim of obtaining good ventricular echocardiograms a higher yield might have been achieved.

(b) The poor results with the relative wall thickness formula demonstrated by Dancy in his 29 patients with high quality echocardiograms do not accord with the findings of several other studies. In fact the coefficients of correlation in the six studies which he grudgingly says "predict left ventricular pressure with some accuracy" and in three other papers<sup>3-5</sup> vary from 0.72 to 0.92. One would not expect a perfect correlation when one set of biological variables (ventricular dimensions) is compared with a different variable (intracardiac pressure).

(c) Dancy demonstrated a fair correlation between aortic valve gradient and diastolic wall thickness and he advocates this measurement in the assessment of aortic stenosis. This finding is not at all surprising because patients with coexistent "established hypertension or important aortic regurgitation" were excluded from his study. Had such patients been included absolute measurement of wall thickness would have appeared less reliable,

whereas assessment of aortic stenosis by measurement of relative wall thickness could still have been applied.<sup>1,2</sup>

(d) Several workers, including Dancy, have pointed out that when the relative wall thickness formula is used, wall stress considerations make the use of diastolic dimensions more appropriate than the use of systolic ones. This makes sense theoretically and indeed I also found a close correlation between diastolic relative wall thickness and gradient<sup>2</sup> but in practice the choice of systolic or diastolic dimensions is probably unimportant because there is a good correlation between peak and end systolic wall stress.

(e) The interval between catheterisation and echocardiography should be stated since aortic stenosis can sometimes progress rapidly.

In patients with aortic stenosis and good left ventricular function (with or without aortic regurgitation or hypertension) in whom unequivocal identification of endocardial and epicardial surfaces can be achieved, a useful estimate of aortic valve gradient can be obtained from relative wall thickness measurement derived from either systolic or diastolic data. The method is better than measurement of diastolic wall thickness alone, which will be influenced by other causes of ventricular enlargement as well as body size. An echocardiographic study is only as good as the quality of its echocardiograms. Many a paper would be strengthened by publication of some of its echocardiograms.<sup>6</sup>

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## References

- 1 Bennett DH, Evans DW, Raj MVJ. Echocardiographic left ventricular dimensions in pressure and volume overload. Their use in assessing aortic stenosis. *Br Heart J* 1975;37:971-7.
- 2 Bennett DH. Echocardiographic assessment of aortic

- stenosis. University of Manchester, 1975. MD Thesis.
- 3 Gewitz MH, Werner JC, Kleinmann CS, Hellenbrand WE, Talner NS. Role of echocardiography in aortic stenosis: pre- and postoperative studies. *Am J Cardiol* 1979;43:67-73.
  - 4 Reichek N, Devereux RB. Reliable estimation of peak left ventricular pressure by M-mode echographic determined end-diastolic wall thickness: identification of severe valvular aortic stenosis in adult patients. *Am Heart J* 1982;103:202-9.
  - 5 Mokotoff DM, Quinones MA, Winters WL, Miller RR. Non-invasive quantification of severity of aortic stenosis by echocardiographic wall thickness-radius ratio. *Am J Cardiol* 1979;43:406.
  - 6 Ramsdale D, Bennett DH. Asymmetric septal hypertrophy in conditions other than IHSS. *Am Heart J* 1980;100:931-3.

Sir,

Dancy (1985;55:155-61) concludes that formulas for predicting left ventricular pressure from echocardiographic recordings are inaccurate. This may well be so but the evidence of this study is not sufficient to prove this point. Quite apart from the fact that analysis by the use of correlation coefficients is inappropriate for the comparison of one technique with another<sup>1</sup> and that catheter data are not without error,<sup>2</sup> there is the overriding consideration that the echocardiographic and catheter measurements of left ventricular pressure were made at different times. It is likely that left ventricular pressure was different at echocardiography than at catheterisation. Just how much the pressure differed we cannot know but it may be that minute to minute and day to day variation is least in those with the most severe aortic stenosis because in such cases the ventricles may of necessity be generating very high pressures almost constantly (until they fail). It would be interesting to know whether in Dancy's series there was better agreement in those with the highest left ventricular pressures.

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#### References

- 1 Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet* 1986;i:307-12.
- 2 Odemuyiwa O, Hall RJC. Assessing the severity of valve stenosis. *Br Heart J* 1986;55:117-9.

These letters were shown to Dr Dancy, who replies as follows:

Sir,

I thank Dr Bennett as well as Dr Wainwright Evans and Dr Raj for their interest in my paper and welcome the opportunity to answer their points.

One of the objects of the paper was to examine the proposal that relative wall thickness is a valuable method for assessing pure aortic stenosis, and I think the results speak for themselves: relative wall thickness gave significant correlations in only 25% of patients; the confidence intervals for the prediction of left ventricular pressure were not as close as those provided by the simple measurement of left ventricular wall thickness; they were not close enough to make clinical decisions in doubtful cases, and certainly not good enough to reduce the need for cardiac catheterisation.

I share the reservations of Wainwright Evans and Raj about the use of correlation coefficients for the comparison of two techniques, though Bennett does not appear to agree, and confuses correlation with predictive value. A highly significant correlation is not necessarily reliable when one variable is predicted from the other. For this reason I plotted confidence intervals. Panel (a) of the figure in my paper shows that even with a correlation coefficient of 0.75, the 95% confidence intervals for prediction of left ventricular pressure from left ventricular wall thickness cover a range of 100 mm Hg.

Cardiac catheterisation was carried out within eight weeks of echocardiography in all patients in my study. I accept that some errors will have been introduced because the studies were not simultaneous and that cardiac catheterisation data are not faultless. These errors, however, will have affected the relation between left ventricular pressure and absolute wall thickness to the same extent as they affected the relation between left ventricular pressure and relative wall thickness. Because absolute wall thickness appeared the better predictor I advocate this simple measurement rather than the more complex less accurate relative wall thickness.

Bennett suggests that relative wall thickness is a better predictor of aortic valve gradient in patients with additional aortic regurgitation or hypertension, but my paper did not examine this point. Were it to be true, it would be logical to restrict the use of the relative wall thickness formulas to such patients—neither hypertension nor important aortic regurgitation are difficult to diagnose clinically.

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